

CLAIMS

1. An insulated gate type semiconductor device comprising:

a body region arranged at upper surface side in a semiconductor substrate, the body region corresponding to a first conduction type semiconductor;

a drift region being in contact with bottom surface of the body region, the drift region corresponding to a second conduction type semiconductor; and

a trench section arranged with penetrating the body region from upper surface of the semiconductor substrate and reaching level further below bottom surface of the body region,

wherein the insulated gate type semiconductor further comprises a floating region surrounded by the drift region, the floating region corresponding to a first conduction type semiconductor,

bottom of the trench section is arranged in the floating region,

in the trench section, there are formed a deposited insulating layer consisting of deposited insulating material and a gate electrode being arranged above the deposited insulating layer and facing the body region, and

top of the deposited insulating layer is further above top of the floating region.

2. An insulated gate type semiconductor device according to claim 1 further comprising an intermediate floating region arranged further above top of the floating region with being surrounded by the drift region, the intermediate floating region corresponding to a first conduction type semiconductor,

wherein the trench section penetrates the intermediate floating

region, and

top of the deposited insulating layer is arranged further above top of the intermediate floating region.

- 5 3. An insulated gate type semiconductor device according to claim 1 further comprising:

an auxiliary trench section arranged with penetrating the body region from upper surface of the semiconductor substrate and reaching level further below bottom surface of the body region, the auxiliary
10 trench section being filled with insulating material inside; and

an auxiliary floating region surrounded by the drift region, the auxiliary floating region corresponding to a first conduction type semiconductor,

wherein bottom of the auxiliary trench section is arranged in
15 the auxiliary floating region.

4. An insulated gate type semiconductor device according to claim 3 wherein depth of the trench section and depth of the auxiliary trench section are different.

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5. An insulated gate type semiconductor device according to claim 3 wherein depth of the trench section and depth of the auxiliary trench section are same.

- 25 6. An insulated gate type semiconductor device comprising:

a body region arranged at upper surface side in a semiconductor substrate, the body region corresponding to a first conduction type semiconductor;

a drift region being in contact with bottom surface of the body region, the drift region corresponding to a second conduction type semiconductor;

5 a trench section arranged with penetrating the body region from upper surface of the semiconductor substrate and reaching level further below bottom surface of the body region; and

a gate electrode arranged in the trench section with facing the body region,

10 wherein the insulated gate type semiconductor device further comprises:

an auxiliary trench section arranged with penetrating the body region from upper surface of the semiconductor substrate and reaching level further below bottom surface of the body region, the auxiliary trench section being filled with insulating material inside; and

15 an auxiliary floating region surrounded by the drift region, the auxiliary floating region corresponding to a first conduction type semiconductor,

wherein bottom of the auxiliary trench section is arranged in the auxiliary floating region.

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7. An insulated gate type semiconductor device according to claim 6 further comprising an auxiliary intermediate floating region arranged further above top of the auxiliary floating region with being surrounded by the drift region, the auxiliary intermediate floating region
25 corresponding to a first conduction type semiconductor,

wherein the auxiliary trench section penetrates the auxiliary intermediate floating region, and

top of the deposited insulating layer is arranged further above

top of the auxiliary intermediate floating region.

8. An insulated gate type semiconductor device according to claim 6 further comprising:

5 a second auxiliary trench section facing the auxiliary trench section with the gate electrode inserted between there, the second auxiliary trench section being arranged with penetrating the body region from upper surface of the semiconductor substrate and reaching level further below bottom surface of the body region, the second auxiliary
10 trench section being filled with insulating material inside; and
a second auxiliary floating region surrounded by the drift region, the second auxiliary floating region corresponding to a first conduction type semiconductor,

wherein depth of the auxiliary trench section and depth of the
15 second auxiliary trench section are different.

9. An insulated gate type semiconductor device according to claim 3 or 6, wherein the auxiliary trench section is structure in dot pattern, viewed from top side of the semiconductor substrate.

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10. An insulated gate type semiconductor device according to at least any one of claims 1 through 9,

wherein in a region around a cell region, there are arranged:
a terminal trench section filled with insulating material inside;
25 and

a terminal floating region surrounded by the drift region, the terminal floating region corresponding to a first conduction type semiconductor, and

bottom of the terminal trench section is arranged in the terminal floating region.

11. Manufacturing method of an insulated gate type semiconductor device which comprises: a body region arranged at upper surface side in a semiconductor substrate, the body region corresponding to a first conduction type semiconductor; a drift region being in contact with bottom surface of the body region, the drift region corresponding to a second conduction type semiconductor; a trench section arranged with penetrating the body region from upper surface of the semiconductor substrate and reaching level further below bottom surface of the body region; and a gate electrode arranged in the trench section with facing the body region, the manufacturing method comprising:

trench section forming step of forming the trench section in the semiconductor substrate on which the drift region and the body regions have been formed;

impurity injecting step of injecting impurity from bottom of a trench section formed in the trench section forming step;

insulating material laying-up step of laying up insulating material in the trench section after impurity is injected through the impurity injecting step; and

floating region forming step of forming a floating region by applying thermal diffusion processing after impurity is injected in the insulating material laying-up step.

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12. Manufacturing method of an insulated gate type semiconductor device according to claim 11 further comprising:

trench section drilling step of further drilling down bottom

of the trench section after impurity is injected in the impurity injecting step; and

impurity re-injecting step of re-injecting impurity from bottom the trench section drilled further in the trench section drilling step.

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13. Manufacturing method of an insulated gate type semiconductor device according to claim 11 or 12, wherein

the trench section is formed in a cell region and a peripheral region of the cell region in the trench section forming step, and

10 the insulating material laying-up step comprises:

insulating material filling step of filling inside of the trench section formed in the trench section forming step with insulating material; and

deposited material adjusting step of adjusting height of a
15 deposited insulating layer by eliminating a portion of insulating material in the trench section filled with insulating material in the insulating material filling step, particularly, the trench section in the cell region.